Autumn Examinations 2015 / 2016

Exam Code(s)	4BCT, 4BLE1, 4BN1,4BP1
Exam(s)	B.Sc. Degree (Computer Science and Information Technology) Bachelor of Engineering (Electrical & Electronic) Bachelor of Engineering (Electronic) Bachelor of Engineering (Electronic & Computer Engineering)
Module Code(s)	CT417
Module(s)	Software Engineering III
Paper No.	I
External Examiner(s)	Dr. John Power
Internal Examiner(s)	Prof. G. Lyons *Dr. Jim Duggan

Instructions:

Answer any 3 questions. All questions carry equal marks.

Duration	2hrs
No. of Pages	
Department(s)	Information Technology

Requirements

1. (a) Define equations for the following measures, and comment on their strengths and weaknesses.

- Programmer Productivity
- Module defect density

(4)

(b) For the following class (which contains information on a product including its quantity in stock), calculate the Lack of Cohesion of Methods (LCOM) measure.

```
class Product
{
      String id;
      double onHand;
      double CONV = 2.54


      public getStockID(){ return this.id}

      public getLevel(){return this.onHand}

      public increment(double amt)
      {
            this.onHand+=amt
      }

   public decrement(double amt)
    {
            this.onHand-=amt
    }

   public double getConversionFactor()
                       {return this.CONV;}

   public double convCM2Inch(double cm)
   {
      return this.CONV*cm;
   }

}
```

(14)

(c) Discuss the result, and comment on the strengths and weaknesses of the LCOM approach.

(2)

2. (a) Assume that the mean time to failure (MTTF) of a software component is 10 time units. Generate a uniform probability distribution function *f(t)* that describes when the product will fail. Based on this, calculate (graphically) the probability that the software will fail between time 8 and time 10.

(6)

(b) A software component has a hazard rate of 0.10. Assuming a probability density function based on the exponential distribution, calculate:

- the MTTF of the system,
- the probability that the system will fail in the first 10 days of operation
- the reliability of the system after 20 days of operation.

What is the significance of the exponential probability distribution function when compared with the uniform distribution from part (a)?

(8)

(c) Define the main assumption underlying the Jelinski-Moranda (JM) model of software reliability. Clearly show the formulation for the hazard rate.

Assuming the initial number of faults (N) in the system is 5, predict the MTTF for the system after each successive system repair. Assume that $\phi = 0.01$, where ϕ is the contribution of each fault to the failure rate.

Plot the sequence of MTTF values and comment on the shape of the curve.

Explain why the JM model suitable as a model of software reliability growth?

(6)

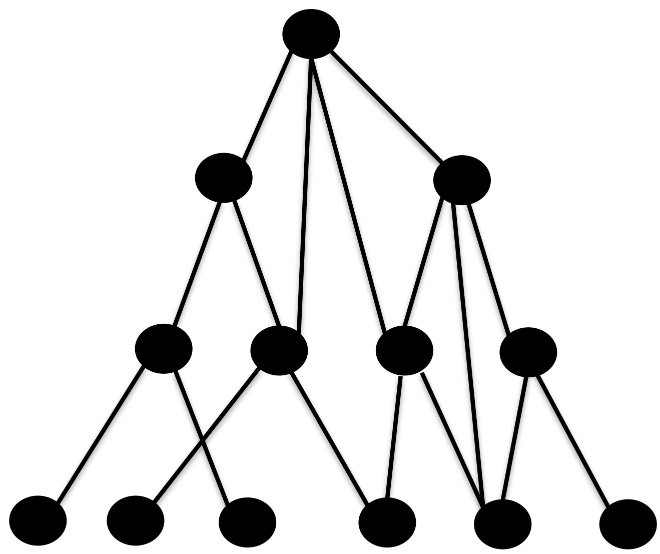
3. (a) Given that the measure for tree impurity, *m(G),* is defined as:

$$m(G) = \frac{number\ of\ edges\ more\ than\ the\ spanning\ tree}{maximal\ number\ of\ edges\ more\ than\ the\ spanning\ tree}$$

Derive the equation for *m(G)*, and show that its maximum value is 1.

(10)

(b) Identify the spanning tree for the following software module design, and calculate the value for *m(G)* and *r(G).*



(7)

(c) Explain why *m(G)* is a useful measure for assessing the potential quality of a software architecture.

(3)

4. (a) "In software engineering, measurement is performed to understand, to control and to improve." Discuss this statement, giving practical examples of how measurement supports each of these activities.

(6)

(b) Define the representational condition for the following *empirical relations* between sensor A and sensor B. Clearly show the relational mapping between the *real world* and the *number system.* For each scenario, select an appropriate *number system* value that can be used.

- A is cheaper than B
- A has more functionality than B
- A consumes more power than B

(10)

(c) Distinguish, using software engineering examples, between the following scales: ordinal, nominal and interval.

(4)